

WHAT IS CLAIMED IS:

1. A superconducting rotating machine comprising:
 - a stator assembly including at least one stator coil assembly having a first predefined length; and
 - a rotor assembly configured to rotate within said stator assembly and spaced from said stator assembly by a gap, said rotor assembly including at least one superconducting rotor winding assembly which, in operation, generates a magnetic flux linking said stator assembly;
 - wherein said rotor assembly includes an asynchronous field filtering shield having a second predefined length which is less than said first predefined length, wherein said shield is positioned between said stator assembly and said rotor assembly.
2. The superconducting machine of claim 1 wherein said asynchronous field filtering shield is constructed of a non-magnetic material.
3. The superconducting machine of claim 2 wherein said non-magnetic material is copper.
4. The superconducting machine of claim 2 wherein said non-magnetic material is aluminum.
5. The superconducting machine of claim 1 wherein said first predefined length is a differential length greater than said second predefined length.
6. The superconducting machine of claim 5 wherein said differential length is a percentage of said first predefined length.
7. The superconducting machine of claim 5 wherein said differential length is a percentage of said second predefined length.

1 8. The superconducting machine of claim 5 wherein said differential length is a fixed
2 length.

1 9. The superconducting machine of claim 1 wherein said at least one stator coil
2 assembly is constructed using a copper non-superconducting material.

1 10. The superconducting machine of claim 1 wherein said at least one superconducting
2 rotor winding assembly is constructed using a high-temperature superconducting material.

1 11. The superconducting machine of claim 10 wherein said high temperature
2 superconducting material is chosen from the group consisting of: thallium-barium-calcium-
3 copper-oxide; bismuth-strontium-calcium-copper-oxide; mercury-barium-calcium-copper-
4 oxide; and yttrium-barium-copper-oxide.

1 12. The superconducting machine of claim 1 further comprising a refrigeration system for
2 cooling said at least one superconducting rotor winding assembly.

1 13. The superconducting machine of claim 1 wherein said at least one stator coil
2 assembly includes a center section and a pair end-turn sections positioned at distal ends of
3 said center section.

1 14. The superconducting machine of claim 13 wherein said asynchronous field filtering
2 shield is positioned between said center section of said at least one stator coil assembly and
3 said at least one superconducting rotor winding assembly, wherein said end-turn sections of
4 said at least one stator coil assembly extend beyond said asynchronous field filtering shield.

1 15. A method of maintaining a sufficient level of subtransient reactance while decreasing
2 the size and cost of a superconducting machine comprising:

3 producing a stator assembly including at least one stator coil assembly having
4 a first predefined length;

producing a rotor assembly configured to rotate within the stator assembly and spaced from the stator assembly by a gap, the rotor assembly including at least one superconducting rotor winding assembly which, in operation, generates a magnetic flux linking the stator assembly;

positioning an asynchronous field filtering shield, having a second predefined length which is less than said first predefined length, between the stator assembly and the rotor assembly; and

reducing the gap between the stator assembly and the rotor assembly to the minimum allowed by mechanical considerations.

16. The method of claim 15 further comprising rigidly affixing the asynchronous field filtering shield to the rotor assembly.

17. The method of claim 15 wherein the at least one stator coil assembly includes a center section and a pair end-turn sections positioned at distal ends of the center section, and positioning an asynchronous field filtering shield includes:

positioning the asynchronous field filtering shield between the center section of the at least one stator coil assembly and the at least one superconducting rotor winding assembly; and

extending the end-turn sections of the at least one stator coil assembly beyond the asynchronous field filtering shield.

18. A method of maintaining a sufficient level of subtransient reactance in a superconducting machine comprising:

producing a stator assembly including at least one stator coil assembly having a first predefined length;

producing a rotor assembly configured to rotate within the stator assembly and spaced from the stator assembly by a gap, the rotor assembly including at least one superconducting rotor winding assembly which, in operation, generates a magnetic flux linking the stator assembly; and

9 positioning an asynchronous field filtering shield, having a second predefined
10 length which is less than said first predefined length, between the stator assembly and
11 the rotor assembly.

1 19. The method of claim 18 further comprising rigidly affixing the asynchronous field
2 filtering shield to the rotor assembly.

1 20. The method of claim 18 wherein the at least one stator coil assembly includes a center
2 section and a pair end-turn sections positioned at distal ends of the center section, and
3 positioning an asynchronous field filtering shield includes:

4 positioning the asynchronous field filtering shield between the center section
5 of the at least one stator coil assembly and the at least one superconducting rotor
6 winding assembly; and

7 extending the end-turn sections of the at least one stator coil assembly beyond
8 the asynchronous field filtering shield.

1 21. A superconducting rotating machine comprising:

2 a stator assembly including at least one stator coil assembly having a first
3 predefined length, said at least one stator coil assembly including a center section and
4 a pair end-turn sections positioned at distal ends of said center section; and

5 a rotor assembly configured to rotate within said stator assembly and spaced
6 from said stator assembly by a gap, said rotor assembly including at least one
7 superconducting rotor winding assembly which, in operation, generates a magnetic
8 flux linking said stator assembly; said rotor assembly including an asynchronous field
9 filtering shield having a second predefined length which is less than said first
10 predefined length, wherein said shield is positioned between said stator assembly and
11 said rotor assembly;

12 wherein said asynchronous field filtering shield is positioned between said
13 center section of said at least one stator coil assembly and said at least one
14 superconducting rotor winding assembly, wherein said end-turn sections of said at
15 least one stator coil assembly extend beyond said asynchronous field filtering shield.

1 22. The superconducting machine of claim 21 wherein said asynchronous field filtering
2 shield is constructed of a non-magnetic material.

1 23. The superconducting machine of claim 22 wherein said non-magnetic material is
2 copper.

1 24. The superconducting machine of claim 22 wherein said non-magnetic material is
2 aluminum.

1 25. The superconducting machine of claim 21 wherein said first predefined length is a
2 differential length greater than said second predefined length.

1 26. The superconducting machine of claim 25 wherein said differential length is a
2 percentage of said first predefined length.

1 27. The superconducting machine of claim 25 wherein said differential length is a
2 percentage of said second predefined length.

1 28. The superconducting machine of claim 25 wherein said differential length is a fixed
2 length.

1 29. The superconducting machine of claim 21 wherein said at least one stator coil
2 assembly is constructed using a copper non-superconducting material.

1 30. The superconducting machine of claim 21 wherein said at least one superconducting
2 rotor winding assembly is constructed using a high-temperature superconducting material.

1 31. The superconducting machine of claim 30 wherein said high temperature
2 superconducting material is chosen from the group consisting of: thallium-barium-calcium-

3 copper-oxide; bismuth-strontium-calcium-copper-oxide; mercury-barium-calcium-copper-
4 oxide; and yttrium-barium-copper-oxide.

1 32. The superconducting machine of claim 21 further comprising a refrigeration system
2 for cooling said at least one superconducting rotor winding assembly.

1 33. A stator assembly, configured to accept a superconducting rotor assembly having an
2 asynchronous field filtering shield of a first predefined length, wherein said shield is
3 positioned between said stator assembly and said rotor assembly comprising:

4 at least one stator coil assembly having a second predefined length, which is
5 greater than said first predefined length.

1 34. The stator assembly of claim 33 wherein said at least one stator coil assembly
2 includes a center section and a pair end-turn sections positioned at distal ends of said center
3 section.

1 35. The stator assembly of claim 34 wherein said asynchronous field filtering shield is
2 positioned between said center section of said at least one stator coil assembly and said at
3 least one superconducting rotor assembly, wherein said end-turn sections of said at least one
4 stator coil assembly extend beyond said asynchronous field filtering shield.

1 36. The stator assembly of claim 33 wherein said asynchronous field filtering shield is
2 constructed of a non-magnetic material.

1 37. The stator assembly of claim 36 wherein said non-magnetic material is copper.

1 38. The stator assembly of claim 36 wherein said non-magnetic material is aluminum.

1 39. A superconducting rotating machine comprising:

2 a stator assembly including at least one stator coil assembly having a center
3 section and a pair end-turn sections positioned at distal ends of said center section;
4 and

5 a superconducting rotor assembly configured to rotate within said stator
6 assembly and spaced from said stator assembly by a gap; wherein said rotor assembly
7 includes an asynchronous field filtering shield positioned between said stator
8 assembly and said rotor assembly;

9 wherein at least one of said end-turn sections of said at least one stator coil
10 assembly is flared radially away from said asynchronous field filtering shield, thus
11 creating an expanded gap between said end-turn sections and said asynchronous field
12 filtering shield.

1 40. The superconducting machine of claim 39 where said expanded gap is two to three
2 times larger than said gap.

1 41. The superconducting machine of claim 39 wherein each said at least one stator coil
2 assembly includes an inner surface and an outer surface, wherein said inner surface is
3 positioned proximate said asynchronous field filtering shield.

1 42. The superconducting machine of claim 41 further including a flux return path
2 positioned circumferentially about said outer surface of said end turn sections of said at least
3 one stator coil assembly.

1 43. The superconducting machine of claim 42 wherein said flux return path is constructed
2 of a magnetic material.

1 44. The superconducting machine of claim 43 wherein said magnetic material is
2 laminated sheet steel.

1 45. The superconducting machine of claim 39 wherein said asynchronous field filtering
2 shield is constructed of a non-magnetic material.

- 1 46. The superconducting machine of claim 45 wherein said non-magnetic material is
2 copper.
- 1 47. The superconducting machine of claim 46 wherein said non-magnetic material is
2 aluminum.
- 1 48. The superconducting machine of claim 39 wherein said at least one stator coil
2 assembly is constructed using a copper non-superconducting material.
- 1 49. The superconducting machine of claim 39 wherein said superconducting rotor
2 assembly includes at least one superconducting rotor winding assembly which, in operation,
3 generates a magnetic flux linking said stator assembly.
- 1 50. The superconducting machine of claim 49 wherein said at least one superconducting
2 rotor winding assembly is constructed using a high-temperature superconducting material.
- 1 51. The superconducting machine of claim 50 wherein said high temperature
2 superconducting material is chosen from the group consisting of: thallium-barium-calcium-
3 copper-oxide; bismuth-strontium-calcium-copper-oxide; mercury-barium-calcium-copper-
4 oxide; and yttrium-barium-copper-oxide.
- 1 52. The superconducting machine of claim 39 further comprising a refrigeration system
2 for cooling said superconducting rotor assembly.
- 1 53. The superconducting machine of claim 39 wherein both of said end-turn sections of
2 said at least one stator coil assembly are flared radially away from said asynchronous field
3 filtering shield.

1 54. The superconducting machine of claim 39 wherein one of said end-turn sections of
2 said at least one stator coil assembly is flared radially away from said asynchronous field
3 filtering shield and the other said end-turn section is non-flared.

1 55. The superconducting machine of claim 54 wherein said non-flared end-turn section is
2 coterminous with said asynchronous field filtering shield.

1 56. The superconducting machine of claim 54 wherein said non-flared end-turn section
2 extends past said asynchronous field filtering shield.

1 57. A superconducting rotating machine comprising:
2 a stator assembly including at least one stator coil assembly having a first
3 predefined length, said at least one stator coil assembly including a center section and
4 a pair end-turn sections positioned at distal ends of said center section; and
5 a superconducting rotor assembly configured to rotate within said stator
6 assembly and spaced from said stator assembly by a gap; wherein said rotor assembly
7 includes an asynchronous field filtering shield having a second predefined length
8 which is less than said first predefined length, wherein said shield is positioned
9 between said stator assembly and said rotor assembly;
10 wherein at least one of said end-turn sections of said at least one stator coil
11 assembly is flared radially away from said asynchronous field filtering shield, thus
12 creating an expanded gap between said end-turn sections and said asynchronous field
13 filtering shield.

1 58. The superconducting machine of claim 57 where said expanded gap is two to three
2 times larger than said gap.

1 59. The superconducting machine of claim 57 wherein each said at least one stator coil
2 assembly includes an inner surface and an outer surface, wherein said inner surface is
3 positioned proximate said asynchronous field filtering shield.

1 60. The superconducting machine of claim 59 further including a flux return path
2 positioned circumferentially about said outer surface of said end turn sections of said at least
3 one stator coil assembly.

1 61. The superconducting machine of claim 60 wherein said flux return path is constructed
2 of a magnetic material.

1 62. The superconducting machine of claim 61 wherein said magnetic material is
2 laminated sheet steel.

1 63. The superconducting machine of claim 57 wherein said asynchronous field filtering
2 shield is constructed of a non-magnetic material.

1 64. The superconducting machine of claim 63 wherein said non-magnetic material is
2 copper.

1 65. The superconducting machine of claim 63 wherein said non-magnetic material is
2 aluminum.

1 66. The superconducting machine of claim 57 wherein said first predefined length is a
2 differential length greater than said second predefined length.

1 67. The superconducting machine of claim 66 wherein said differential length is a
2 percentage of said first predefined length.

1 68. The superconducting machine of claim 66 wherein said differential length is a
2 percentage of said second predefined length.

1 69. The superconducting machine of claim 66 wherein said differential length is a fixed
2 length.

1 70. The superconducting machine of claim 57 wherein said at least one stator coil
2 assembly is constructed using a copper non-superconducting material.

1 71. The superconducting machine of claim 57 wherein said superconducting rotor
2 assembly includes at least one superconducting rotor winding assembly which, in operation,
3 generates a magnetic flux linking said stator assembly.

1 72. The superconducting machine of claim 71 wherein said at least one superconducting
2 rotor winding assembly is constructed using a high-temperature superconducting material.

1 73. The superconducting machine of claim 72 wherein said high temperature
2 superconducting material is chosen from the group consisting of: thallium-barium-calcium-
3 copper-oxide; bismuth-strontium-calcium-copper-oxide; mercury-barium-calcium-copper-
4 oxide; and yttrium-barium-copper-oxide.

1 74. The superconducting machine of claim 57 further comprising a refrigeration system
2 for cooling said at least one superconducting rotor winding assembly.

1 75. The superconducting machine of claim 57 wherein both of said end-turn sections of
2 said at least one stator coil assembly are flared radially away from said asynchronous field
3 filtering shield.

1 76. The superconducting machine of claim 57 wherein one of said end-turn sections of
2 said at least one stator coil assembly is flared radially away from said asynchronous field
3 filtering shield and the other said end-turn section is non-flared.

1 77. The superconducting machine of claim 76 wherein said non-flared end-turn section is
2 coterminous with said asynchronous field filtering shield.

1 78. The superconducting machine of claim 76 wherein said non-flared end-turn section
2 extends past said asynchronous field filtering shield.

1 79. A method of maintaining a sufficient level of subtransient reactance while decreasing
2 the size and cost of a superconducting machine comprising:

3 producing a stator assembly including at least one stator coil assembly having
4 a center section and a pair end-turn sections positioned at distal ends of the center
5 section;

6 producing a superconducting rotor assembly configured to rotate within the
7 stator assembly and spaced from the stator assembly by a gap;

8 positioning an asynchronous field filtering shield between the stator assembly
9 and the rotor assembly;

10 flaring the end-turn sections of the at least one stator coil assembly radially
11 away from the asynchronous field filtering shield, thus creating an expanded gap
12 between the end-turn sections and the asynchronous field filtering shield; and

13 reducing the gap between the stator assembly and the rotor assembly to the
14 minimum allowed by mechanical considerations.

1 80. The method of claim 79 further comprising rigidly affixing the asynchronous field
2 filtering shield to the rotor assembly.

1 81. The method of claim 79 further comprising positioning a flux return path
2 circumferentially about the outer surface of the end turn sections of the at least one stator coil
3 assembly.